# 109

LASER SCAR REVISION:
AN ANALYSIS OF PULSED DYE LASER TREATMENT
WITH AND WITHOUT INTRALESIONAL CORTICOSTEROIDS

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**Purpose:** To determine whether combination pulsed dye laser-intralesional corticosteroid treatment produced better hypertrophic scar improvement than pulsed dye laser treatment alone.

**Methods:** Twenty-two patients with bilateral hypertrophic breast reduction scars (inframammary) were treated with the 585nm pulsed dye laser (fluences 4.5-5.5 J/cm$^2$, 10mm spot). The scars on one breast were randomly and blindly selected to receive additional treatment with intralesional corticosteroids (Kenalog 5mg/cc). Clinical evaluations were obtained 6 weeks following each of 2 consecutive treatments. Blinded histopathologic correlations were made when possible.

**Results:** Significant improvement was seen in all treated scars. No differences were observed between scars that were treated with laser alone versus those treated with concomitant corticosteroids except in instances when active (proliferative) and symptomatic (pruritic) scars were present. Side effects were limited to purpura, transient hyperpigmentation, and treatment pain.

**Conclusions:** Pulsed dye laser treatment of hypertrophic scars is preferable to combination treatment with intralesional corticosteroids in most patients.

# 110

TREATMENT RESPONSE OF KELOIDAL AND HYPERTROPHIC STERNOTOMY SCARS: COMPARISON BETWEEN INTRALESIONAL CORTICOSTEROID, AND/OR 5-FLUOROURACIL, AND THE 585 NM FLASHLAMP-PUMPED PULSED-DYE LASER. Woraphong Manuskiatti, Richard E. Fitzpatrick. Dermatology Associates of San Diego County, Inc., La Jolla, CA

Purpose: This management of keloids and hypertrophic scars is challenging. We compare the clinical response of keloidal and hypertrophic sternotomy scars to intralesional corticosteroid alone or combined with 5-fluorouracil (5-FU), 5-FU alone, and the 585 nm flashlamp-pumped pulsed-dye laser (PDL).
Method: Ten previously untreated, erythematous keloidal or hypertrophic median sternotomy scars of 10 individuals were divided into 5 segments and were randomly treated with 4 different regimens: 1) Laser irradiation with 585 nm PDL (7 J/cm$^2$, 5 mm spot) q4wks x 6 treatments. 2) Intralesional(IL) triamcinolone (TMC) at a concentration of 20 mg/ml, q4 wks x 6 treatments. 3) IL 5-FU (50 mg/ml) for 10 treatments. 4) IL TMC (1 mg/cc) mixed with 5-FU (45 mg/cc) for 10 treatments. One segment of each scar received no treatments and served as a control. Clinical assessments including scar height, erythema and pliability were evaluated before, and every 8 weeks for a total course of 32 weeks.
Results: There was a significant clinical improvement on all treated segments. No statistically significant differences in treatment outcome versus methods of treatment used was seen. However, the resolution rate of the areas treated with all IL formulas was comparable and was noted at an earlier follow-up period than those treated with the PDL. Adverse sequelae including hypopigmentation, telangiectasia, and skin atrophy were seen in 50% (5/10) of the segments that received corticosteroid injection alone while no adverse sequelae were demonstrated in the segments treated with the other treatment modalities.
Conclusions: Clinical improvement of keloidal and hypertrophic scars following treatments of IL corticosteroid alone or combined with 5-FU, 5-FU alone, and the 585 nm PDL appear comparable with 2 exceptions. The IL formulas provide a more rapid response and IL corticosteroids are much more prone to cause side effects.

# 111

A COMPARISON OF LONG PULSED ALEXANDRITE LASER AND SCLEROTHERAPY FOR THE TREATMENT OF LOWER EXTREMITY SPIDER VEINS. Daniel A. Buscaglia and Constance Rutkowski, Cosmetic Vein and Laser Center, Buffalo, New York.
The Long Pulsed Alexandrite laser (LPA) has recently shown promise in the treatment of spider veins of the lower extremity. However, a direct comparison of the effectiveness of this laser with traditional sclerotherapy has not been reported. The purpose of this study was to determine the effectiveness of LPA laser, sclerotherapy and successive treatment of both, on lower extremity spider veins.
Twelve subjects, with spider veins measuring 0.5-3 mm diameter, were treated on three occasions at 6 week intervals. One spider vein cluster per subject was arbitrarily divided into 3 segments. One segment received LPA laser irradiation (20 J/cm$^2$, 12.5 mm spot, 10 msec pulse width, double pulse technique), one segment received sclerotherapy (23.4% hypertonic saline), and one segment received sclerotherapy followed immediately by LPA laser irradiation. Follow-up evaluations and photographs were completed at each treatment and 3 months after the last treatment.
LPA "laser only" sites demonstrated a 9%, 26%, and 30% mean improvement after 1, 2, and 3 treatments respectively. The "sclerotherapy only" sites demonstrated a 59%, 91%, and 92 % mean improvement after 1, 2, and 3 treatments respectively. Sites that received both techniques demonstrated a 65%, 87%, and 93% improvement after 1, 2, and 3 treatments respectively.
LPA laser irradiation alone demonstrated minimal to moderate improvement in spider veins, when compared to sclerotherapy which demonstrated good to excellent improvement. Sclerotherapy followed immediately by LPA laser irradiation failed to show significant advantage over sclerotherapy alone. However, in select cases, this combination treatment seemed to enhance the results of sclerotherapy, and may aid in treating resistant spider veins.

# 112*

THE USE OF REFRIGERATED AIR OR CONTACT COOLING FOR THE TREATMENT OF LEG VEINS WITH A 755NM, 20 and 40 MSEC LASER.

Emil A. Tanghetti, Sacramento, California; Robert M. Adrian, Washington, D.C.

Purpose: The clearance of abnormal leg veins up to 2mm in diameter has been demonstrated with various 755nm millisecond pulse duration lasers. This study was conducted using a novel refrigerated air-cooling device and a contact cooling device to facilitate higher fluences and multiple-pass laser treatments.
Methods: 20 patients with abnormal leg veins measuring .5 to 2.0 mm were treated. Each patient received two treatments to four defined target areas with the Long Pulse Alexandrite (755nm) laser. One area was treated with a refrigerated air cooling device another with a contact cooling apparatus. 20 and 40 msec pulse durations were used in each patient with fluences of up to 50 J/cm$^2$. Multiple passes were given until vessel disappearance or an intravascular clot was observed. An additional treatment was administered at week four for resistant vessels.
Results: Patients were re-evaluated at 4, 8, and 12 weeks after treatment. Efficacy was determined by investigator evaluation and blinded photographic analysis. Incidents and types of adverse effects were noted. The advantages of both the refrigerated air cooling device and contact cooling of abnormal leg veins during long pulse Alexandrite laser treatments are discussed.

Conclusions: The use of either refrigerated air cooling or contact cooling facilitates the clearance of abnormal leg veins by permitting the use of higher fluences and multiple passes with the long pulse Alexandrite laser.

# 113*

**A CLINICAL COMPARISON OF 810 NM DIODE AND LONG PULSED 1064 NM NEODYMIUM:YAG LASERS IN THE TREATMENT OF LEG VEINS**

Robert M. Adrian, Linda Griffin, Kathy Spargo, Georgetown University Medical School, Center for Laser Surgery, Washington, DC

Although a wide variety of laser and nonlaser thermal devices are available for the treatment of lower extremity telangiectasia, their role remains poorly defined and controversial. Long pulsed Alexandrite 755 nm and Diode 810 nm lasers have been used to treat leg veins, however, their success has been limited. Recently long pulsed Neodymium:YAG lasers have been introduced for the treatment of leg veins.

We had the opportunity to compare in a bilateral fashion a new high energy 810 nm Diode laser and a 1064 nm long pulse ND:YAG laser in the treatment of leg veins. Twenty patients, Fitzpatrick skin types II and III, with primary lower extremity telangiectasia were studied. Diode sites received single 50 J to 60 J/cm2 pulses by means of a contact cooling device. Nd:YAG sites received single pulses at 75J - 95 J/cm2 at 40 msec pulse durations with and without passive cooling. Patients were treated and evaluated monthly for 6 months. Although small red vessels showed no response to either laser, both lasers were somewhat effective in clearing small and medium-size blue telangiectasia and small reticular veins. Both lasers produced postinflammatory pigmentation and vascular blushing was noted in 10% of patients. Our data suggests that both Diode and long pulsed Nd:YAG lasers are useful in the treatment of blue-colored lower extremity telangiectasia.

# 114*

DUAL WAVELENGTH APPROACH FOR LASER/FLASHLAMP TREATMENT OF LOWER EXTREMITY VEINS

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**Purpose of Study:** To show that a bimodal wavelength approach to laser/flashlamp treatment of lower extremity veins produces superior results to previously described methods. Examination of red telangiectasia shows that they are more superficial in location compared to blue venulectasia and reticular veins. Shorter wavelengths (500-600 nm) most effectively treat Class I oxygenated reddish telangiectasia. Longer wavelengths (800-1100 nm) more effectively treat Class II-III deoxygenated bluish venulectasia and reticular veins.

**Materials and Methods:** 50 female patients age 20-42 (mean 37 years) (Fitzpatrick skin types 2-4 with Class I-III telangiectasias/venulectasias/ reticular veins) were treated with a combined approach as follows with up to three treatments at 6 week intervals on a 5 $cm^2$ surface of vessels. Red vessels < 1 mm broad spectrum flashlamp, $\lambda$ 550 nm, double pulse 2.4/6.0 msec, pulse delay 20 msec, fluence 40J/$cm^2$, spot size 8 x 35 mm. Blue vessels 1064 Nd:YAG laser, single pulse, pulse duration 14 msec, fluence 140 J/$cm^2$, spot size 6 mm. Vein disappearance was assessed by digital imaging (double blinded observer) and optical chromatography (Minolta Systems, Osaka, Japan).

**Results:** An average of 2.5 treatments produced 100% clearing in 80% of patients as proven by clinical and chromatographic optical studies. The mean erythema index was reduced to 1.0 (-da).

**Conclusions:** A new effective 1064 nm Nd:YAG laser produces reproducible clinical photothermolysis in large diameter blue lower extremity vessels 1-4 mm in diameter. A dual wavelength mode utilizing a broad spectrum flashlamp (550 nm) treats reddish Class I telangiectasis 1.0 mm or less in diameter.

# 115*

**ONE YEAR RESULTS WITH THE LONG PULSED 1064NM LASER FOR LEG TELANGIECTASIAS**

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The role of lasers and intense pulsed light sources in treatment of leg veins continues to evolve. We have used a near infrared laser 1064nm with pulse durations of up to 16 msec on leg telangiectasias up to 3mm for over one year. Over 150 patients have been treated, with an average of 3 sites per patient. The average size of telangiectasia treated is 0.8 mm (0.3mm – 3mm). Fluences have ranged from 110 – 150 J/cm2. Improvement was judged by comparison of digital images (640x480, 16M colors, fluorescent lighting) at one month, two months and three months post treatment. Five categories of improvement based on size and number of vessels remaining were assigned at one year post-treatment. Results demonstrated an average of 2.38 treatments were required for patients to note satisfactory improvement, which numerically rated a 3.25 (approximately 75% improvement) by photographic evaluation. Side effects included hyperpigmentation (16%) which appeared very similar to post-sclerotherapy hyperpigmentation and resolved in 95% at the 6 month follow-up. Telangiectatic matting was noted in 4%. Minor epidermal injury was noted in only one treatment site. At one year follow-up, the long pulsed millisecond domain 1064nm laser remains an effective modality for closure and subsequent clearance of leg telangiectasias with efficacy and side effects comparable to other methods.

# 116

**PULSED DIODE LASER 940 NM:**
**FIRST EXPERIENCES ON THE TREATMENT OF LEG VEINS**

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Various types of laser systems have been employed for the treatment of leg vein teleangiectasia. So far these attempts have not been effective enough to replace conventional sclerotherapy. It was the purpose of the study to evaluate the efficacy of the new 940 nm diode laser for the treatment of leg veins. The wavelength 940 nm takes the advantage of a minor peak in the absorption spectrum of the oxyhemoglobin to achieve effective and selective absorption of laser light in wide vessels. Deeper penetration into the skin and less epidermal damage is expected due to less scattering and less absorption by melanin.

Thirty-five female patients with leg vein teleangiectasia on the upper and lower legs were included into the study. Vessels with a diameter from 0.3 to 1.0 mm were treated with the diode laser 940 nm (Dornier *Medilas D Skinpulse*) using handpieces with spot diameters 1.0 and 1.5 mm and fluences of 300 to 400 J/$cm^2$. The pulse durations were set between 50 and 70 ms and were shorter than the thermal relaxation times of the vessels. Patients received up to three treatments at 4 weeks

interval. Effect of the treatment was assessed by two independent investigators on standardized sequential photographs taken prior to each treatment and four weeks after the last treatment. Clearing was graded into 5 grades representing 20% intervals from grade 1 = 0% up to 20 % clearance to grade 5 = above 80% clearance.
After one single treatment clearing did not exceed grade 2 in most patients. Clearing, however, improved with additional treatments of the same vessel. After three sessions grade 2 persisted in 4 patients, grade 3 was achieved in 10 patients, grade 4 in 15 patients, and grade 5 in 2 patients. Hyperpigmentation was observed in 2 patients but faded after 2 - 3 months. Superficial skin textural changes occurred in 1 patient with wide superficial vessels.
Our results indicate that the 940 nm diode laser is a promising device for effective treatment of leg vein teleangiectasia. Increased efficacy is to be expected from an improved version of this laser providing high fluences at shorter pulse duration and variable spot sizes.

# NEUROSURGERY

## 119

LASER DIAGNOSIS AND TREATMENT OF DEEP-SEATED BRAIN LESIONS
Helen Anne Ward
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The five year survival rate of deep-seated malignant brain tumours after surgery/radiotherapy is virtually 100% mortality. Special problems include: (1) Lesions often present late; (2) Position - lesion overlies vital structures, so complete surgical/radiotherapy lesion destruction can damage vital brain-stem functions; (3) Difficulty in differentiating normal brain from malignant lesions.
The aim and method of this study was to use the unique properties of the laser: (2) to minimise damage during surgical removal of deep-seated brain lesions by operating via fine optic fibres; and (b) to employ the propensity of certain lasers for absorption of (non toxic) dyes and absorption and induction of fluorescence in some brain substances, to differentiate borders of malignant and normal brain, for more complete tumour removal. The project resulted in a fine laser endoscopic technique for removal of brain lesions, which minimised thermal damage and shock waves. A compatible endoscopic fluoroscopic laser technique was developed. This differentiated brain tumour from normal brain.
It was concluded that by utilising special properties of coherent light wavelengths, a more precise, less damaging technique for laser removal/diagnosis of brain tumours was achieved.

## 120

OPTIMAL LIGHT DOSE FOR INTERSTITIAL PHOTODYNAMIC THERAPY IN TREATMENT FOR MALIGNANT BRAIN TUMORS:
Satish Krishnamurthy, Stephen K Powers, Peggy Witmer, TonyBrown
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The optimal safe light dose for the treatment of recurrent malignant astrocytomas using interstitial photodynamic therapy (PDT) was studied in 18 patients. Histological diagnosis was glioblastoma multiforme in 9 patients, and anaplastic astrocytoma in 8 patients and one patient with malignant ependymoma. Average solid tumor volume was 33cc with tumors ranging in size from 4 to 80 cc. Each patient received Photofrin 2 mg/kg body weight intravenously 24 hours prior to photoillumination with 630 nm light from an argon-pumped dye laser. In order to determine the optimal laser light dose, patients were each treated with a total of 7 optical fibers with 6 of the fibers peripherally positioned parallel and equidistant (2.1 cm) from an optical fiber placed along the central tumor axis. The total light dose delivered to the tumor could be divided into three groups – less than 3500J, 4000J and more than 4500J.
Significant neurotoxicity (delayed onset hemiparesis) occurred in 3 patients that received over 4,000 J. Each group had 6 patients. Half of the patients treated with a light dose of more than 4500J had delayed neurological deficits whereas two out of six patients treated with a light dose of 4000J had delayed neurological deficits. None of the patients who received less than 3500J had increase in deficits.
In conclusion, interstitial PDT is an effective and safe means of controlling local glioma recurrence at a maximal light dose of approximately 4,000 J. There was a tendency for PDT in lesions close to the motor cortex to result in delayed neurological deficits.

## 121

FLUORESCENCE-GUIDED RESECTION OF GLIOBLASTOMA UTILIZING 5-ALA-INDUCED PORPHYRINS
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Laser Research Laboratory and Department of Neurosurgery and Neuropathology of the University of Munich

**Objective:** 5-Aminolevulinic acid (5-ALA) induces the accumulation of fluorescent protoporphyrin IX in glioblastoma multiforme, a phenomenom potentially exploitable for enhancing resection of this tumor entity. We now analyze the influence of fluorescence-guided resection on post-operative magnetic resonance imaging (MRI) and survival.
**Methods:** Fiftytwo consecutive patients with glioblastoma multiforme received 20 mg 5-ALA/kg b.w. orally 3 hours prior to anesthesia. Intraoperatively, tumor fluorescence was visualized using a modified operating microscope. Fluorescing tissue was removed whenever considered safely possible. Residual enhancement on post-operative MRI, obtained within 72 hours after surgery, was quantified and related to patient's characteristics to determine which factors influenced resection. Survival was analyzed using the Kaplan-Meier method and multivariate analysis considering Karnofsky status, age and degree of resection, as determined from early post-operative MRI.
**Results:** Complete resection of enhancing tumor was accomplished in 63 % of patients. Residual intra-operative tissue fluorescence intentionally left unresected correctly predicted residual enhancement on MRI in 18 of 19 patients. Age, residual fluorescence and absence of contrast-enhancement on MRI were independent explanatory factors for survival.
**Conclusions:** Our observations demonstrate that resection guided by 5-ALA-induced tumor fluorescence enhances resection safely, and prolongs survival in patients suffering from glioblastoma multiforme.

## 122

EXCIMER LASER ASSISTED NEURO BYPASS PROCEDURE: MECHANISM ANALYSED BY VISUALIZATION TECHNIQUES
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Over the last years a unique neuro-surgical procedure has been developed and successfully applied in over 100 patients with either aneurysms or tumors, creating a high-flow bypass in the brain without temporal occlusion of the recipient artery. In this technique 308-nm Excimer laser pulses cut a 2-mm hole in the recipient arterial wall using a ring shaped multiple fiber catheter, which is introduced through a donor artery. The cutout portion is attached by vacuum to a grid in the center of the fiber ring and retrieved with the catheter. To refine the technique, the wall perforation during laser exposure was studied in detail using high-speed and thermal camera techniques.
The Excimer laser pulses (120 ns, 10 mJ) showed to cut through the recipient artery by a combined vaporizing and mechanical effect. During tissue ablation explosive vapor bubbles are formed with diameters up to 300 μm which expand and collapse within 150 μs, locally rupturing the arterial wall. Ablation products were observed as permanent gas bubbles and microscopic debris (~ < 50 μm) which are assumed to be harmless for the perfusion of the brain. The typical 200 μm thick arterial wall was almost always circularly perforated within 200 pulses at 40 Hz without significant thermal effects. However, thicker and multi-layered walls were only partially perforated resulting in a potential hazardous flap in the arterial lumen. Tissue detachment from the grid was observed when the wall retracted during perforation resulting in a vacuum loss and blood interference.
The safety and reliability of this wall perforation technique may be further improved by reducing the explosive effects during ablation, enhancing the wall suction technique and selective fiber exposure of the ring catheter.

# 123

USE OF LASERS IN ENDOSCOPIC NEUROSURGERY:

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This is a review of advantages and disadvantages of using laser in endoscopic neurosurgery in our 15-year experience. Laser is used in adjunct to endoscopy as it is easily transmitted via fiberoptic bundles and can be used for hemostasis, for cutting tissue or for vaporization of tissue.

Our initial experience was with argon laser as a means of coagulating blood vessels. Argon is very useful in coagulating bleeding from choroid plexus and shrinking vascular tumors. However, the use of laser energy in the ventricular system causes heating of the cerebrospinal fluid and can cause significant damage to the hypothalamus during endoscopic third ventriculostomy. Some lasers (Nd:YAG) have wavelengths that are absorbed by the blood vessels and can result in injury to the basilar artery. These disadvantages have prompted us to use a monopolar bugbee catheter as a coagulating device in closed ventricular system.

Both pulsed mode and the continuous modes of KTP/Nd:YAG lasers need to be used with irrigation of fluid or with air cooling device when used in neurosurgery. There is experimental evidence to suggest that high energy pulses of Ho:YAG laser can cause morphological damage to neural tissue remote from the point of application. Diode lasers (0.805 micron) have a high penetration in tissues that are nonpigmented (like white matter) and can cause tissue damage that is not readily recognized during surgery.
Lasers of different wavelengths can be extremely helpful in endoscopic neurosurgery if advantages and limitations are considered in every situation.

# 124

LASER-ASSISTED NEUROENDOSCOPY USING DIODE LASER WITH 'BLACK' FIBER TIPS FOR TREATMENT OF HYDROCEPHALUS

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Endoscopic ventricular fenestration is being applied for the treatment of obstructive hydrocephalus using electrical or blunt mechanical devices. To improve the safety and efficiency of this procedure, a special laser catheter was developed consisting of an atraumatic ball-tip that was pretreated with a layer of carbon particles absorbing 90% of the laser energy. The temperature at the surface of this 'black' tip reaches ablative temperatures instantly at powers of only a few watts within one second. This drastically limits the laser power and the length of exposure needed, increasing safety, even around critical structures. The characteristics of the 'black' tips were studied using a thermal imaging technique, showing the heating could be controlled within 0.2 mm in front of the tip in contrast to uncoated fiber tips.
The 'black' tips were applied in combination with a 810 nm Diode laser in 98 patients and a variety of procedures: third ventriculocisternostomy (n=73), cyst fenestration (n=15), colloid cyst resection (n=7) and fenestration of the septum pellucidum (n=3). The 900 μm 'black' tip on top of a 400 μm fiber was guided through the 1 mm working channel of a 2.3 mm semi-flexible endoscope to the target tissue. Power ranged from 0.5 to 3 W in 0.5 to 2 s exposures and the average total energy for ventricular fenestration was 160 J. There was no mortality, nor increased morbidity. The procedure success rate was 100% and the clinical outcome success rate was 83%.
'Black' atraumatic ball-shaped fiber tips are safe and effective in a variety of neuro-endoscopic procedures. Due to the low power range of only several watts, compact diode lasers are the energy source of first choice.

# 125*

ENDOSCOPIC FORAMINOPLASTY: A PROSPECTIVE STUDY ON 250 CONSECUTIVE PATIENTS WITH INDEPENDENT EVALUATION

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Objectives. The objective has been to assess the efficacy of endoscopic aware state pain source definition using the system of "viviprudence" combined with endoscopic decompression of the foramen, mobilisation and neurolysis of the exiting and transiting nerves and ablation of osteophytes and other causes of the 'failed back syndrome' guided by patient feedback.
Methods. This prospective study involved "daycase" Endoscopic Laser Foraminoplasty performed on 121 males, and 129 females with an average age of 48 years (22-86 years). They were followed for an average period of 30 months (26-43 months). 75 Patients had had 1 – 3 previous open operations. 19 patients were on narcotic analgesics prior to surgery. At other centres, 142 patients were evaluated and open surgical procedures were not deemed appropriate or likely to be of benefit.
Results. 97% cohort integrity was maintained at the final follow up. Back, buttock and leg pain were separately compared and analysed using the *percentage change in Oswestry Disability Index*, and *percentage change in visual analogue pain (VAP) scores*, a Patient Satisfaction Scoring Scale and a patient Target Achievement Score. Clinically appreciable change was observed in 74% patients with back pain, 77% buttock pain, and 75% leg pain. Using a *percentage change in Oswestry*

*Disability Index* of 50 or more to determine good and excellent outcomes, 61% of patients exceeded this score for back pain; 66% for buttock pain; and 65% for leg pain. 94% patients required no further surgical intervention.
Conclusion. These results indicate that Endoscopic Laser Foraminoplasty provides a minimalist means of exploring the extraforaminal zone, the foramen and the epidural space and performing discectomy, osteophytectomy, perineural neurolysis. It incorporates the prophylactic advantage of foraminal undercutting and provides a promising means of identifying and treating the pain of 'failed back surgery' and back pain and sciatica of indeterminate origin.

# 126

PERCUTANEOUS MICRODECOMPRESSIVE ENDOSCOPIC CERVICAL DISCECTOMY WITH RECENTLY ADDED APPLICATION OF NON-ABLATIVE LOWER LASER ENERGY (LASER THERMODISKOPLASTY) - 200 CASES, 1997.

John C. Chiu, Thomas Clifford, Richard C. Richley, Mark Greenspan, Felix Negron, Robert A. Princenthal, California Center for Minimally Invasive Spine Surgery

Purpose: To demonstrate safety, efficacy and technique of outpatient Percutaneous Microdecompressive Endoscopic Cervical Discectomy performed for symptomatic cervical herniated nucleus pulposus. In addition, low energy non-ablative Holmium laser has been applied for shrinking and tightening effect on the disc.
Materials and Methods: Between 1994 and 1997, 200 patients (360 Discs) who failed at least 12 weeks of conservative care were treated. Levels were C2 to C7, inclusive. All patients demonstrated unilateral radicular pain of a specific dermatome confirmed with EMG/NCV. MRI or CT scans demonstrated a contained soft cervical disc. Percutaneous Microdecompressive Endoscopic Cervical Discectomy technique is described. Non-ablative lower Holmium laser energy was added for disc shrinkage.
Results: Average time to return to work was ten days for the non-workers' compensation patient. At an average follow-up of 25 months ( 7 months to 42 months) 94.51% of patients had symptomatic relief. There were no postoperative complications. Holmium laser at non-ablative lower level was utilized to shrink or to tighten the disc. Only eleven patients demonstrated persistent neck and upper extremity pain associated with paresthesia.
Conclusion: This Percutaneous Microdecompressive Endoscopic Cervical Discectomy with added application of non-ablative lower Holmium laser energy for disc shrinkage (laser thermodiskoplasty) appears to be easy, safe and efficacious. This less traumatic outpatient treatment leads to faster recovery and significant economic savings.

# 127

OUT PATIENT BASED MINIMALLY INVASIVE ENDOSCOPIC THORACIC DISCECTOMY WITH LASER THERMODISKOPLASTY FOR NON-EXTRUDED THORACIC HERNIATED NUCLEUS PULPOSUS - 75 CASES.

John C. Chiu, Thomas Clifford, Romulo Sison, Richard C. Richley, Mark Greenspan, Felix Negron, Robert A. Princenthal, California Center for Minimally Invasive Spine Surgery

Purpose: To demonstrate the safety and efficacy of outpatient based endoscopic thoracic discectomy with laser thermodiskoplasty performed for symptomatic thoracic herniated nucleus pulposus.
Materials and Methods: Since February 1996, 75 patient's (114 discs) with symptomatic thoracic discs without myelopathy, who failed at least 12 weeks of conservative care, were treated. The technique of percutaneous microdecompressive endoscopic thoracic discectomy (with laser thermodiskoplasty) by posterolateral approach is described. The thoracic disc levels were T1 to T12. All patients demonstrated a contained soft thoracic disc herniation on MRI or CT scans. Intraoperative thoracic discogram and pain provocative tests were positive and confirmed the disc involved.
Results: Preliminary postoperative follow-up demonstrates 96% of all patients had symptomatic relief. There were no postoperative complications. Two patients demonstrated persistent, though reduced thoracic pain and paresthesia. The average time to return to work was ten days for the non-workers' compensation patients. Most of the patients received non-ablative lower laser energy application for thoracic disc shrinkage or tightening.
Conclusion: Percutaneous microdecompressive endoscopic thoracic discectomy with added application of non-ablative lower Holmium laser energy for disc shrinkage (laser thermodiskoplasty) appears to be easy, safe and efficacious. This less traumatic, easier outpatient treatment leads to excellent results, faster recovery, and significant economic savings

# 128

TREATMENT OF LARGE EXTRUDED HERNIATED LUMBAR DISC BY COMBINED MINIMALLY INVASIVE TRANSFORAMINAL AND TRANSPINAL CANAL ENDOSCOPIC SPINAL SURGERY - CASE

John C. Chiu, Thomas Clifford, Hartyoun Yousif, Robert A. Princenthal, Romulo B. Sison, California Center for Minimally Invasive Spine Surgery

Purpose: To describe the rationale and efficacy of a new outpatient surgical technique combining percutaneous transforaminal and transpinal canal percutaneous microdecompressive endoscopic lumbar discectomy with laser thermodiskoplasty performed for symptomatic large and/or extruded herniated lumbar discs which otherwise would require a more traumatic and difficult open lumbar laminectomy requiring dissection, exploration and discectomy.
Materials and Methods: Twenty-seven patients with large or extruded lumbar discs protruding into the lumbar spinal canal and/or foramen were operated upon by new combined transforaminal and paramedian transpinal canal percutaneous endoscopic microdecompressive discectomy successfully. Preoperatively all the patients demonstrated unilateral radicular pain, confirmed with EMG/NCV, MRI scans were positive for a large extruded L3, L4 or L5 herniated disc. Conventional posterior lateral or transforaminal approach alone for percutaneous lumbar discectomy is not adequate to treat a large disc involving both the intra and extraspinal canal. The technique is described, and two illustrative cases described. In addition, lower level non-ablative laser energy was applied for disc shrinkage for laser thermodiskoplasty
Results: Preliminary postoperative results demonstrated the feasibility and efficacy of this outpatient combined percutaneous microdecompressive endoscopic lumbar discectomy approach to remove otherwise difficult large lesions. The patients had symptomatic relief. There were no postoperative complications. The time to return to work was ten days on average after surgery.
Conclusion: A newly developed combined percutaneous transforaminal (postero-lateral approach) and transpinal paramedian microdecompressive endoscopic lumbar discectomy technique was developed for large and extruded lumbar disc protrusions. This technique allows minimally invasive surgical treatment for a lesion that otherwise would require a more traumatic open lumbar laminectomy with its higher complication rate, longer recovery time and greater cost.

# NURSING/ ALLIED HEALTH

# 131

A LASER RENTAL COMPANY IN A RURAL REGION: A RETROSPECTIVE REPORT

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A viable, safe and cost effective laser rental company provides state-of-the-art laser technology through a fee-for-service structure that is operated by highly qualified professionals experienced in clinical laser procedures. An investigation was completed to verify the effectiveness of a laser rental company in a rural region.
A retrospective study of 16 contracted medical facilities who requested laser rental service over a 6 year period were surveyed. The data collected was distance from the rental location, number of surgical

suites, total laser cases performed, physician specialty and type of wavelength(s). In conjunction, the "Laser Service Rental Agreement" parameters recorded were equipment, site scheduling, medical facility support, fee structure, term and termination, covenants of the laser rental company and medical facility, damages, warranties, indemnity and confidentiality.
In this retrospective study, a laser rental company in a rural region is a viable, safe and cost effective method for providing state-of-the-art laser technology with justifiable adverse circumstances when optimal parameters are chosen.

# 132

**COMPARING TREATMENT OUTCOMES BETWEEN PHYSICIAN AND NURSE TREATED PATIENTS IN LASER HAIR REMOVAL**

**Bruce M. Freedman, Robert V. Earley – McLean, Virginia**

The purpose of this study was to determine whether there were differences in outcome following laser hair removal between patients treated by a trained physician and patients treated by a trained, supervised nurse. 100 patients were treated over a twelve month period for unwanted body hair on the face, torso, and extremities using the Cynosure long pulsed Alexandrite laser. Each patient received an average of 3.4 treatments. Laser parameters were determined by the physician according to Fitzpatrick skin type and hair color. Both physician and nurse were trained and certified in laser technology. Patients were examined and surveyed 3 months following the conclusion of the treatment period. Documentation was obtained with digital photography. 50 patients were treated by a physician (P) and 50 patients were treated by a nurse (N). There were no significant differences between groups in age, gender, and treated areas. Patients in (P) noted an average reduction in hair of 74+/-8 %. Patients in (N) noted an average reduction in hair of 70+/-6%. These values were statistically comparable ($P < .05$). There were self-reported transient skin changes that included pigmentation changes and blistering. Of these, 8 were in (P) and 7 were in (N). This represented no statistical difference between the groups ($P < .05$). Patient satisfaction with the treating clinician was evaluated using an assessment scale of 1(excellent) to 5 (poor). Group (P) reported a satisfaction rating of 1.6 +/- .3 while group (N) reported a satisfaction rating of 1.4 +/- .3. Patients in (P) and (N) were comparably satisfied with their clinical care. Using treatment efficacy, complication rate, and patient satisfaction as parameters, this study concluded that properly trained physicians and properly trained, supervised nurses achieved parallel results in laser hair removal.

# 133

**ESTABLISHING A HOSPITAL-BASED PHOTODYNAMIC THERAPY PROGRAM: REPORT ON OUR INITIAL TEN-YEAR EXPERIENCE**

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Following many years in basic and clinical research, Photodynamic Therapy (PDT) is emerging as a viable, non-invasive oncologic therapy in the hospital and outpatient surgery setting. With the first clinical indications clearing regulatory hurdles, new operational issues are facing hospital-based laser programs including reimbursement, physician credentialling, allied health competencies, internal and external marketing, mobile outreach, equipment reliability and technology assessment. This study discusses special considerations and challenges encountered developing a hospital-based PDT program and shares our initial ten-year experience. Recommendations and guidelines for physicians, allied health personnel, program administrators and laser operators supporting PDT procedures are also presented.

# 134

**THE NURSE'S ROLE IN NON-ABLATIVE LASER REMODELING**

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**Purpose:**
To review the laser protocol using a 1.32$\mu$m Nd:YAG laser and outline a nursing guide to appropriate patient selection, procedural set-up, and long-term postoperative management.

**Objectives:**

- The participant will understand the theory behind non-ablative laser remodeling.
- The participant will be able to correctly identify appropriate patients for treatment.
- The participant will exhibit a thorough understanding of appropriate laser protocol.
- The participant will be able to recognize treatment sequelae and correctly implement therapeutic interventions.

# 135

**DIODE LASER HAIR REMOVAL OF THE BLACK PATIENT**

Ivani Greppi, Richard O. Gregory, Celebration Institute of Aesthetic Surgery, Celebration, Florida

The 810nm wavelength diode laser can safely and successfully treat all skin types, including dark pigmented skin. Three black patients with pseudofolliculitis barbae were treated with the diode laser using low energy settings with excellent results. The pseudofolliculitis barbae condition resolved and the facial hair was greatly reduced. Complications such as hyperpigmentation or hypopigmentation occurred, but all were transient resolving within a few months.

# 136*

THE NURSE'S ROLE IN PHOTODYNAMIC THERAPY FOR AGE-RELATED MACULAR DEGENERATION

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Age-related macular degeneration (AMD) is the major cause of blindness in people over the age of 50 in the western world and until recently, those suffering from the worst form of AMD ("wet" macular degeneration) had limited hope of maintaining their vision. Today there is a bright spot in the treatment of this disease: Photodynamic Therapy. To provide good patient teaching, it is essential for the nurse to understand both the underlying disease process of "wet" AMD and this new therapy. This paper addresses the nurse's role in caring for and providing teaching to these patients who undergo photodynamic therapy to preserve and stabilize their remaining vision.

# 137*

THE TREATMENT OF DARK-SKINNED INDIVIDUALS (SKIN TYPES V & VI) WITH THE INTENSE PULSED LIGHT SOURCE, A NEW CUT-OFF FILTER FOR EPILATION

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Lasers and light sources have become the preferred method for long-term epilation. The majority of the devices on the market successfully remove hair which is dark in color and work best in light-skinned individuals. The current study investigated the intense pulsed light source in patients of skin types V & VI. Seventy-eight individuals were evaluated, 80 anatomical sites (26 skin type V, 54 skin type VI) after one treatment with the intense pulsed light source and a 755 nm cut-off filter. Results show that after 12 weeks, 63% hair reduction was found. Side effects included post-treatment erythema in 88% of the individuals which resolved by 2 weeks and up to 6% post-treatment hyperpigmentation. The new 755 nm cut-off filter with the intense pulsed light source allows all skin types to be successfully treated with this hair removal device.

# 138

LENTIGO VS. LENTIGO MALIGNA: A CASE REPORT

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This paper will present the pitfalls of laser surgery as exampled by this case of lentigo maligna.

A 55-year-old male presented in November, 1997 with a hyperpigmented macule about the right lower eyelid. The lesion, at that time, had several shades of brown, but it had no red, white or blue. No irregularities were seen when examined with an episcope, specifically to rule out lentigo maligna. The area was treated with the Q-switched ruby laser. The patient was seen again and retreated in December, 1997. Six months later the lesion recurred and was treated a third time. On August 17, 1998, the patient presented with a recurrent lesion. A biopsy was performed on September 4, 1998 to rule out lentigo maligna. The biopsy results revealed intraepidermal proliferation of atypical cells. The patient was referred for excisional surgery and subsequently underwent Mohs Surgery. This case brings out two obvious problems. One is the treatment of lesions without histologic diagnosis even though they appear benign clinically, even with examination by an episcope. Secondly, lesions that recur after treatment, such as benign lentigo, should always be considered suspicious and be biopsied to rule out other diagnostic possibilities.

# 139

COMPLICATIONS AND SIDE EFFECTS ASSOCIATED WITH THE USE OF LASER HAIR REMOVAL SYSTEMS

Linda Griffin, Alison B. Buczek, Robert M. Adrian, Center for Laser Surgery, Washington, DC

At the present time numerous laser medical devices are available for laser-assisted hair removal. Unfortunately widely varying claims regarding clinical efficacy, side effects and complications have led to patient confusion. Over the past few years we have had the opportunity to evaluate five different laser hair removal systems. Each system has specific characteristics, side effects and complications underscoring the necessity that laser hair removal procedures should be medically supervised. We will present our experience with each system with particular attention to safety issues, side effects and complications. Guidelines for integrating these procedures in a medical practice will be discussed.

# 140

LASER REMOVAL OF RADIATION THERAPY TATTOO MARKERS

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Radiation therapy tattoo markers are persistent and troublesome reminders to cancer survivors. We present our experience using the Coherent VersaPulse laser as an effective and safe method for removing these tattoos. The purpose of this study is to document and define wavelength preference, parameters and treatment sessions necessary to provide the most efficacious laser treatment protocol for the removal of radiation therapy tattoo markers. Our methodology includes the utilization of both the 755nm Alexandrite and the 1064nm YAG wavelengths of the VersaPulse laser. Treatment settings for the 755nm: 3mm spot size, 6.0J/cm2 and for the 1064nm: 3mm spot size and 5.5J/cm2. Patients have been randomly treated with either the 755nm or the 1064nm or a combination. To date, five study patients with India ink radiation markers have been treated. Four with Fitzpatrick skin type II and one skin type III. Treatment sessions have ranged from 4-8 weeks apart. Complications of pain, blistering, hypo/hyperpigmentation, infection and delayed wound healing have not been seen. Transient purpura and erythema have been noted in all subjects. Preliminary conclusions indicate a preference for the 1064nm at the above settings. Effective clearing of pigment dye appears to require two treatment sessions, 6 weeks apart. As stated, the early results indicate the above preference, however, our study is not complete as of this date. All study subjects will have completed treatment by December 1999.

## 141*

ONE YEAR FOLLOW-UP OF INTENSE PULSED LIGHT HAIR REMOVAL THERAPY

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Initial research with the Intense Pulsed Light PhotoDerm system has been proven significant in long term epilation of hair follicles. The purpose of this study is to investigate the efficacy of epilation using ESC Medical EpiLight system for hair removal during a 1 year period.

Over the last 12 months, 73 patients with 114 sites underwent multiple treatments with skin types 1 - 4 on various body sites. Wavelengths of 570, 590, 615, 645, and 695 nm cut-off filters were utilized in single, double or triple pulse durations. Fluence ranged from 42 to 50 joules with 20 to 40 msec delays. Photographs and hair counts were conducted at treatment sessions. Treatment intervals for facial hair were timed between 4 to 6 weeks apart for the first 3 sessions. Areas on other body sites were performed between 8 to 12 weeks apart with further time intervals planned as needed. The percentage of hair loss. was documented at the point of the last treatment - not at each treatment interval.

Preliminary results indicate that the EpiLight Hair Removal System can produce a safe and effective photoepilation on all colors of hair. Darker pigmented hairs responded the best with an average of 77.8% after 4 treatments. Blond/red hair had the least response with an average epilation of 57% after 3 treatments. Additional analysis of the optimum parameters and outcomes is presently underway to determine the most significant long term efficacy for the patient.

# OTOLARYNGOLOGY/ PULMONARY

## 144

Er:YAG LASER STAPEDOTOMY – EXPERIMENTAL STUDIES AND CLINICAL APPLICATION

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Purpose: To develop optimized parameters for laser stapedotomy and to evaluate the use of the Er:YAG laser in clinical application. Methods: In an experimental setting a study on 54 human petrous bones was performed to determine optimized laser energy parameters for dissection of the posterior crus of the stapes and for perforation of the foot plate. With these parameters stapedotomy was performed in 23 patients suffering from otosclerosis. The incudostapedial joint and the tendon of the stapedius muscle were carried out by conventional dissection. The Er:YAG laser was set at 60-100 mJ and the dissection of the posterior crus and the perforation of the foot plate was achieved by the application of 3-6 pulses. Results: No intra- or postoperative complications were observed in all 28 patients. Neither vertigo nor hearing loss were evident. The improvement of the postoperative hearing results (improvement of the air-bone gap) were significant in all cases (median of persisting air-bone gap: 7.7 dB). The median operation time was 29 min. (range: 15-42 min.) and did not show a significant prolongation in comparison to the conventional technique. In one of 28 patients the perforation of the foot plate had to be carried out conventionally. Conclusion: Er:YAG laser parameters could be optimized and refined in a human petrous bone model and transferred into clinical practice. According to the presented results the Er:YAG laser seems to be a very suitable instrument for stapedotomy.

## 145*

CHROMIUM, THULIUM, HOLMIUM:YTTRIUM ALUMINUM GARNET (CTH:YAG, 2091 NM) LASER FOR BONY ABLATION: PRELIMINARY INVESTIGATION

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The Children's Hospital of Philadelphia
University of Pennsylvania School of Medicine

**Purpose:** To determine feasibility of fiber-delivered CTH:YAG laser energy for bone ablation.
**Methods:** Gross and histopathologic evaluation of silica-fiber delivery of CTH:YAG energy against fresh human calvarial bones.
**Results:** CTH:YAG permits bone ablation through bone 1-3 mm thick. Tissue effects seen grossly include charring adjacent to the impact site, and histopathologically, limited thermal injury. A significant flare results from increased fluences.
The 550 micron diameter fiber has allowed the most consistent drilling of bone.
**Conclusions:** Fiber delivery of CTH:YAG energy is effective for drilling short distances through bone. Thermal effects - flare and char - require further evaluation before clinical application.

## 146*

ALTERNATIVE INDICATIONS FOR LASER TYMPANIC MEMBRANE FENESTRATION

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Our purpose was to assess the utility of the OtoLAM flash scan laser in the management of ear disease beyond the traditional indications of Otitis Media with Effusion (OME) or Acute Otitis Media (AOM).
A retrospective review of the records of 104 children and one adult comprising 187 ears treated with the OtoLAM flash scan laser between July 1, 1998 and June 30, 1999 was conducted. Specific data regarding indications other than AOM or OME were identified. Laser power, duration, spot size and clinical outcome was recorded.
Seven children and one adult were treated by laser tympanic membrane (TM) fenestration in the office, at the bedside or in the operating room. Two had drainage of middle ear fluid in conjunction with sedated Brainstem Evoked Response Audiometry. This allowed auditory assessment without delays awaiting the natural resolution of middle ear fluid and precluding the need of tympanostomy tubes.
One child had early mastoiditis. The laser allowed office middle ear drainage and culture avoiding treatment delays. One child had neutropenia and otitis media and required auditory assessment prior to initiating chemotherapy. Middle ear ventilation and material from culture was obtained by performing the procedure under sedation at the bedside. Auditory assessment was unable to be accomplished prior to healing of the fenestrations. One child had TM fenestration for the evaluation of a possible middle ear mass. Resolution of the suspicious middle ear findings was achieved. Two children

underwent laser debridement of tympanic membrane perforations in conjunction with myringoplasty. Poor healing and recurrent perforation occurred. One adult suffered barotrauma while scuba diving. Middle ear ventilation hastened resolution.
This preliminary investigation demonstrates the ability to rapidly fenestrate the TM for diagnostic as well as therapeutic purposes. Based on the findings and outcomes of the procedure, specific management can be tailored to the individual patients' needs. Laser TM fenestration can be accomplished in the office or at the bedside with the use of topical anesthetic ear drops, possibly with sedation, or the procedure can be done under a general anesthetic. This broadens the procedure's versatility. The laser did not appear to be effective, in the technique we used, to achieve TM perforation closure with myringoplasty.

# 147*

Laser assisted Septal Surgery

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**Background:** Nearly half the world's population suffers from nasal airway obstruction. The majority of cases occur when hypertrophic inferior turbinate, deviated or broadened septal cartilage or bone narrows the nasal passages. The laser alternative for septal surgery several advantages over conventional septal surgery. These include that it is an in office procedure done under local anesthesia, tends to be bloodless with minimal pain, instant unblocking of nasal passages and no nasal packing is required, thus making it a simple, fast and cost effective procedure.
**Study design:** Prospective study of patients undergoing Laser assisted Septal Surgery (LASS)
**Institution:** A tertiary care teaching hospital
**Material and Methods:** Patients with nasal septal deformity with or without turbinate hypertrophy underwent Laser assisted septal surgery using the char-free CO2 laser system under local anesthesia in the office. A layer by layer tissue evaporation was performed and the nasal septal deformity reshaped. Patients with associated turbinate hypertrophy underwent laser assisted turbinate ablation as an adjunct to Laser assisted septal surgery.
**Results:** 96% of patients who underwent LASS had significant improvement in their symptoms of nasal obstruction. The patients were able to resume normal activity immediately and had minimal postoperative pain. There were no cases of recurrent septal deviation, septal perforation, nasal adhesions or atrophic rhinitis.
**Conclusions:** LASS is a safe and effective method of treating patients with nasal obstruction due to septal deformity. It is a fast, convenient and cost-effective procedure.

# 148

LASER-MEDIATED CARTLAGE RESHAPING WITH FEEDBACK-CONTROLLED CRYOGEN SPRAY COOLING: BIOPHYSICAL PROPERTIES AND VIABILITY. [1]Karamzadeh AM, [2]Tanenbaum BS, [3]Milner TE, [1]Rasouli A,[1]Nelson JS, [1]Basu R, [1]Wong BJF. [1]Beckman Laser Institute and Medical Clinic, UC Irvine, [2]Dept. of Engineering, Harvey Mudd College, [3]Dept. of Elect. and Computer Engineering, UT at Austin
The purpose of this investigation was to measure changes in cartilage optical and thermal properties during Nd:YAG ($\lambda$=1.32 $\mu$m, 50 PRR, 5 mm spot size) laser radiation with and without cryogen spray cooling (CSC), and determine chondrocyte viability following reshaping using these methods. Fresh porcine septal cartilage was cut into uniform strips and irradiated using a Nd:YAG laser (50 W/cm$^2$) with and without CSC. Dynamic changes in tissue optical and thermal properties were measured and used to determine the minimum laser pulse duration required to initiate mechanical stress relaxation in the specimen. Surface temperature was estimated using a thermopile infrared detector, which also triggered cryogen delivery (10ms pulse duration 1,1,1,2, tetrafluorethane) at 50°C. Diffusely reflected light from an amplitude modulated diode probe laser ($\lambda$= 650nm, 5mW) was simultaneously collected with an optical fiber and detected with a silicon photoreceiver using a lock-in amplifier. Following 1.5 to 2.0 seconds of laser exposure, characteristic changes in diffuse reflectance (indicating the onset of accelerated stress relaxation) was observed in both laser only and laser with CSC specimens. In the CSC groups, surface temperatures never exceeded 50-52 °C; in contrast to non-CSC laser irradiated specimens where surface temperatures exceeded 65-75°C, near the theoretical threshold for protein denaturation. To demonstrate reshaping, specimens were secured onto a cylindrical (1cm diam.) wire-mesh jig and irradiated (2 sec) with and without CSC either once or twice sequentially over the entire specimen surface. Photographs of specimens were taken prior to reshaping and after 14 days of storage in saline solution at 4 °C. After 14 days, specimens in all groups retained their original curved shape. In parallel, chondrocyte viability studies were performed immediately following reshaping. Irradiated regions were excised, placed in tissue culture, and then enzymatically digested. Cell viability was determined using hemocytometry with trypan blue and fluorescence flow cytometry. Chondrocyte viability was significantly ($p<0.05$) increased with the use of CSC [94.4±6.0%(1-pulse) and 70.1±16.4%(2-pulse)] versus without CSC [68.7±20.1%(1-pulse) and 28.4±26.0%(2-pulse)]. CSC during high power laser irradiation allows rapid heating with minimization of extreme front surface temperature elevations and axial thermal gradients. Cartilage grafts are effectively reshaped with CSC which also provides the additional advantage of increasing chondrocyte viability within the laser irradiated region.

# 149

LASER SURGICAL REDUCTION OF HYPERTROPHIED INFERIOR TURBINATES IN CHILDREN
Authors: Folz BJ, Lippert BM, Werner JA; Dept. of Otolaryngology, Head and Neck Surgery, Philipps-University Marburg, Germany
Introduction: Perennial nasal congestion in children may be due to hypertrophied inferior turbinates and adenoids. If conservative therapy provides no relief, the surgical management should be aimed on the restoration of a normal anatomy and physiology. Nasal congestion can be reliefed very gently by laser reduction of the turbinates, sometimes combined with adenoidectomy. Methods: A total number of 52 children aged 4-15 years were treated for hypertrophied inferior turbinates by $CO_2$ (45 patients) and Nd:YAG (7 patients) laser surgery. In 9 patients additional adenoidectomy was performed. Parents and children were asked to fill out a standardized questionnaire similar to those of Weider and Sulzner (1998). Results: A number of 43 patients completed the questionnaire at one year follow-up and were included in this study. "Single Spot"-$CO_2$ laser therapy had been performed in 35 cases, non-contact Nd:YAG laser therapy was performed in 8 cases. Postoperative nasal packing had been applied in 10 cases, which was usually removed after three hours. Repacking was not necessary after the packings once had been removed. A total of 39 patients reported a significant improvement of nasal breathing, three children reported an unchanged status, one child claimed a worsened state. Crusting, synechiae, unpleasant odours or bleeding did not occur. Topical medication (nasal steroid spray) was continued by 5 children. The laser surgical procedures found good acceptance by the parents, 90.2 % of the parents would again sign informed consent to this type of treatment. Conclusion: Laser therapy for hypertrophied inferior turbinates seems to be an adequate treatment in children, as it provides reliable relief of nasal blockage at a low complication rate and hardly any discomfort for the children.

# 150

PERIOPERATIVE TREATMENT CONCEPT OF LASER SURGICAL TISSUE BRIDGE DISSECTION IN ZENKER'S DIVERTICULUM

Authors: Lippert BM, Folz BJ, Werner JA; Dept. of Otolaryngology, Head and Neck Surgery, Philipps-University Marburg, Germany

Introduction: Endoscopic tissue bridge dissection with the $CO_2$ laser has found good acceptance for treatment of Zenker's diverticulum. However with this technique the mediastinum is always opened and perioperative complications like gastroesophageal reflux and vomiting may cause mediastinitis. If these complications occur they are not unlikely to become fatal. Purpose of study: To develop a perioperative treatment concept to minimize complications after laser surgical tissue bridge dissection in Zenker's diverticulum. Methods: Based on the experience of 15 years of uncomplicated $CO_2$ laser tissue bridge dissection, the most recent 27 patients were treated perioperatively by a standardized protocol. The protocol consisted of the perscription of an antacid (Ranitidin 150 mg twice daily for 14 days), an antiemetic (Odansentron 4 mg twice daily for 7 days) an antipyretic (Metamizol 500 mg three times daily) and the application of i.v. antibiotics (Metronidazol 500 mg three times daily and Cefuroxim 1500 mg three times daily for three days, continued by oral therapy for 4 days) starting the day before surgery. At the end of the actual surgery all patients received a nasogastric tube. Tube feeding was performed for two days, on day two oral diet was started with clear liquids. On day 3 patients were permitted to swallow tube feeding diet orally and on day 4 patients received a soft diet, regular diet was started on day 5. Results: Obstructed deglutition was relieved in all 27 patients. No complications could be observed. Monitoring of inflammation parameters did not reveal signs of infection. Conclusion: $CO_2$ laser tissue bridge dissection is a safe and reliable procedure provided the proper perioperative care is given. By the presented protocol possible complications could be averted in a series of 27 patients.

# 151

ORAL CAVITY INTRINSIC AUTOFLUORESCENCE

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Laser induced fluorescence has been used to study the biochemical composition and morphological structure of tissue. Our study focused in obtaining intrinsic autofluorescence from different sites in the oral cavity of normal volunteers. Intrinsic fluorescence is important in that it is free of distortions arising from the interplay of absorption and scattering.

Multiple spectra of different sites in the oral cavity were obtained from 20 healthy volunteers with a Fast EEM, an instrument for rapid acquisition of clinical excitation-emission fluorescence spectra. Clinical data were collected using 11 excitation wavelengths ranging from 337 to 620 nm, along with white light reflectance with an optical fiber probe in 0.5 seconds. An approximation for the intrinsic fluorescence lineshape was obtained by applying a mathematical algorithim dividing the fluorescence by the simultaneously recorded diffuse reflectance.

Large spectral alterations caused by hemoglobin absorption were successfully removed using our mathematical algorithim. Major differences were noted with 337 nm excitation wavelength both on spectral intensity and shape. Sites in the oral cavity were categorized into two groups according to their spectral shape. The differences between the groups can be attributed to the normal distribution of the various types of collagen present in the oral cavity.

Intrinsic fluorescence may provide important information about the exact biochemical composition of tissues without the spectral changes caused by hemoglobin absorption and light scattering. Better understanding of normal tissue fluorescence is the first step to distinguish those changes caused by disease.

# 152

FLUORESCENCE BRONCHOSCOPY FOR THE LOCALIZATION OF EARLY STAGE TUMORS

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The clinical pilot study evaluated practicability, benefit and limitations of fluorescence bronchoscopy using an incoherent excitation light source.

For excitation of 5-aminolevulinic-acid (5-ALA, medac, Hamburg, FRG) induced protoporphyrin IX (PPIX) fluorescence (380 nm-435 nm) or autofluorescence (380 nm-460 nm) a filtered xenon-light-source (D-Light/AF, K. Storz, Tuttlingen, FRG) is used. Backscattered blue excitation light is blocked to about 99% by appropriate longpass filters mounted in the eyepiece of a modified flexible bronchoscope (Storz BC11004). Fluorescence can be detected visually, by an integrating endo-camera (Storz telecam SL-PAL-PDD) or focally with a fiber-based spectrometer.

For the bronchoscopic fluorescence diagnosis with PPIX, 5-ALA was applied with a nebulizer (200 mg 5-ALA in 5 ml isotonic saline). Spectral data are calibrated and normalized for distance by using scattered light at 860 nm.

For both imaging methods (68 and 97 patients) – autofluorescence and PPIX-fluorescence – the sensitivity for the detection of severe dysplasia and carcinoma in situ could be appr. doubled compared to white light alone. Specificity was not significantly different from white light bronchoscopy.

Both imaging methods demonstrate the potential for an increased bronchoscopic detectability of early stages of bronchial carcinoma.

# 153

FLUORESCENCE DETECTION OF HEAD AND NECK TUMORS USING 5-AMINOLEVULINIC ACID

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**Introduction:** The prognosis of patients suffering from head and neck tumors can be improved by early diagnosis. Exact demarcation of tumor margins could contribute to an optimum preservation of the affected organ. Therefore, the aim of our study was the evaluation of 5-aminolevulinic acid (5-ALA)-induced protoporphyrin IX (PPIX)-fluorescence as a new diagnostic procedure for the detection of oral and laryngeal neoplasias.

**Methods:** 62 patients with suspected oral malignancies performed a 15 minute rinsing of the oral cavity using 0.5 wt. % 5-ALA solution. 26 patients suffering from laryngeal neoplasms received 0.6 wt. % 5-ALA-NaCl solution with use of a medical nebulizer. After 1–2h the patients underwent direct laryngoscopy under white light and fluorescence

excitation (λex=375-440nm). A quantitative analysis of the fluorescence contrast between neoplastic and surrounding tissue was performed using an optical multichannel analyzer.
**Results:** In both the oral cavity as well as in the larynx, strong red fluorescence from 5-ALA induced PPIX was observed in the area of the lesions. The surrounding normal tissue exhibited autofluorescence in the green spectral range, which was considerably reduced within the neoplastic tissue. The results of macroscopic red fluorescence staining were correlated with the histological diagnosis. Excellent results of fluorescence staining was also noted for papillomas in the oral cavity and larynx.
**Conclusions:** The topical application of 5-ALA seems to be a promising adjunct diagnostic procedure for the early identification and demarcation of malignant neoplasms in the head and neck area. For the first time this procedure was used for the successful fluorescence staining of papillomas. The aim of further investigations are the evaluation fluorescence-guided laser tumor resections following oral 5-ALA application (per os).

# 154

## REDUCED POST-OPERATIVE MORBIDITY AFTER RADICAL SURGERY AND COMPLEX RECONSTRUCTION FOR ADVANCED HEAD AND NECK CANCER USING HYPERBARIC OXYGEN THERAPY AND LASER SURGERY

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This study determined whether or not peri-operative hyperbaric oxygen (HBO) therapy and the neodymium-yttrium-aluminum garnet (Nd:YAG) laser scalpel during surgery reduced the frequency of post-operative complications after composite head and neck cancer resections with complex reconstructions. The medical records of thirty-one consecutive surgical patients who underwent thirty-two composite resections of advanced operable cancers of the head and neck with immediate tissue transfer reconstruction were evaluated retrospectively. After prior radiotherapy (4500 to 7560 cGy), 22 patients (HBO/YAG) underwent 23 Nd:YAG resections and reconstructions, as well as peri-operative HBO, where nine patients received both pre- and post-operative HBO, and fourteen received only post-operative HBO. Eight patients underwent standard surgery (STD) without peri-operative HBO, five of whom received pre-operative radiation therapy (3240 to 7680 cGy). Twenty of 22 HBO/YAG patients (90.9%) and six of eight STD patients (75%) had Stage IV cancers. Demographic differences between the HBO/YAG and STD groups were not statistically significant. There were no flap failures in HBO/YAG group, which was a significant improvement from the STD group with a 37.5% flap failure rate (p=0.013). Dehiscence was also significantly reduced from 62.5% in the STD group to 13% in the HBO/YAG group (p=0.013). Finally, HBO/YAG patients demonstrated a significant decrease in further site-related surgical procedures in that 50% of STD patients required additional surgery compared with only 8.7% of HBO/YAG patients (p=0.026). This study demonstrated that the combined use of HBO and the Nd:YAG laser scalpel in irradiated patients with advanced head and neck cancer significantly reduced post-operative complications.

# 155

## Fibro-laryngoscopic YAG laser therapy of glottic carcinoma and its effect on cellular immune function

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**To explore the therapeutic effectiveness of Nd:YAG laser vaporization on glottic Tis and T1 tumors and its effect on the cellular immune function. 32 cases of patients with glottic Tis or T1 squamous cell carcinomas were treated with YAG laser vaporization by fibro-laryngoscope. Both before and after therapy, the serum levels of soluble interleukin-2 receptor(SIL-2R),and interleukin-2(IL-2) as well as activity of natural killers(NK) were determined by using double-antibody sandwich technique, tritiated thymidine-deoxyribonucloside incoporation, and iodine 125-uridine-deoxyribonucloside release techniques, respectively. The results showed that 31 of the 32 patients are alive, and 26 of the 32 patients were followed up for 3 to 7 years, the recurrence rate was 12.5%(4/32) and cure rate 84.6%(22/26). The post-YAG laser therapy serum level of SIL-2R was significantly declined (P<0.001) while that of IL-2 and the activity of NK were significantly increased (P<0.001) as compared with those of pre-therapy. Our results suggest that the therapy with YAG laser vaporization by fibro-laryngoscope is effective, sample and safe for the patients with glottic Tis and T1 tumors, and has an immuno-enhancing effect on the host.**

# 156

## OPTICAL-THERMAL SIMULATION OF HUMAN TONSILLAR TISSUE IRRADIATION: CLINICAL IMPLICATIONS

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Mucosa Intact Laser Tonsillar Ablation (MILTA) has been proposed as an alternative to conventional tonsillectomies. Preliminary reports have established the efficacy of this procedure in canine models. With the beginning of clinical trials for the MILTA procedure on the horizon, establishing the safety and efficacy of irradiating human tonsils is paramount. An optical-thermal simulation of tissue irradiation was developed and applied to tonsillar tissue. This study, currently in press, demonstrated the safety of the MILTA procedure in irradiating human tonsils at 10 watts of power for 1 minute at 805 nm. Though the effect of varying dosimetries on human tonsillar tissue was not investigated. The present study, via this optical-thermal simulation, demonstrates the temperature rise in human tonsillar tissue irradiated at 805 nm for 1 minute at powers of 5 to 25 watts. At powers greater than 10 watts, the mucosa will become damaged. The deeper parts of the tonsil (8-10 mm) have a negligible peak temperature rise despite a five-fold increase in the power. The optical-thermal simulation facilitates exploration of various dosimetry regimens prior to clinical trials, leading to safer and more efficacious procedures. This study presents the optimal dosimetry parameters for irradiation of human tonsillar tissue at 805 nm with the MILTA technique.

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## OROPHARYNGEAL LASER APPLICATIONS

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Many of the properties of the laser make use in the oral cavity and oropharynx advantageous. The ability to cut, coagulate for hemostasis and ablate tissue with

precision, are a few of the reasons behind the popularity of laser use in this area. Examples of laser use in the oral cavity include tongue and mucosal biopsy, ablation of surface lesions and laser assisted uvulopalatoplasty for snoring and sleep apnea. Carbon dioxide and KTP lasers will be principally described. The presentation will outline indications for use, technique, and the results of application of this technology.

# 158

**PATHOGENESIS OF GLOTTIC AND SUBGLOTTIC STENOSIS: RELEVANCE TO $CO_2$ LASER TREATMENT**

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Purpose: 1) To review the spectrum of lesions and pathogenesis of glottic and subglottic stenosis, and 2) to discuss lesion morphologies that are amenable to $CO_2$ laser treatment. Methods: A Medline search was conducted for all topics related to glottic and subglottic stenosis, including basic science evaluation of pathogenesis, retrospective clinical reviews and surgical treatment options using the $CO_2$ laser. Results: Major categories of glottic stenoses were found to be anterior glottic web, posterior glottic stenosis, subglottic stenosis, and glottic stenosis related to conservation surgery for laryngeal cancer. Categories of pathogenesis include congenital, iatrogenic, traumatic, inflammatory and autoimmune. Morphologies include short segment, multi-level and long segment stenoses, and membranous versus "mature." When pharmacologic treatment of contributing medical conditions fails, the use of the $CO_2$ laser has been shown to be variably effective in treating stenoses. Laser treatment is more effective with short segment and membranous stenoses.Effectiveness is also improved with adjunctive treatment, such as atraumatic bronchoscopic dilation, mucosal preservation and the emerging use of topical antifibrotic agents. Also, methods to decrease heat deposition in surrounding tissue during laser use decreases the reactive inflammatory response, thereby further improving effectiveness. Conclusions: The spectrum of lesion sites, pathogenesis and morphologies of glottic/subglottic stenosis is relevant to pre-operative surgical planning and prognosis.

# 159

**CO2-LASER ASSISTED ENDOSCOPIC SUPRAGLOTTIC LARYNGECTOMY. INDICATIONS AND RESULTS.**

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Endoscopic supraglottic pharyngo-laryngectomies can be included in the scale of procedures for the supraglottic tumors as endoscopic cordectomies are for glottic cancers. Good exposition is paramount and can be obtained with bi-valve or Kastenbauer® scopes. If exposition is doubtful, open surgery must be preferred. Indications are early cancers (T1-T2)

Without invasion of the preepiglottic space whom complete endoscopic resection is very difficult to complete. Changing the position of the scope is frequently necessary. One of the difficulties is the control of the internal branch of the superior laryngeal artery, running under the pharyngo-epiglotttic fold. Coagulation or microvascular clips can be useful. Four endoscopic procedures are systematized in our department : anterior supraglottic laryngectomy without the preepiglottic space, anterior laryngectomy including the preepiglottic space, lateral supraglottic laryngectomy, limited excision. Neck dissection are realized during the same procedure. Radiotherapy on the neck can be discussed in case of N0. Feeding is resumed the day after the procedure under control of speech therapists and is usually much easier than by open neck surgery thanks to the preserved function of the inferior and superior hyoid muscles.

# 160

**CARBON DIOXIDE LASER MICROSURGERY OF BENIGN VOCAL FOLD LESIONS : INDICATIONS, TECHNIQUES AND RESULTS.**

Remacle-M; Lawson-G; Jamart-J. University Hospital of Louvain at Mont-Godinne, Yvoir, Belgium

More than 300 carbon dioxide laser-assisted cases of microphonosurgery are reported. Carbon dioxide laser-assisted microphonosurgery is efficient, provided the working parameters are strictly adhered to: micromanipulator micropoint providing a 250-microm laser beam for a 400-mm working distance; 0.1-second single pulses; and maximum power of 3 W with the superpulse wave. Glutaraldehyde-cross-linked collagen remains our filling material of choice in cases of vocal fold atrophy. Fibrin glue is useful for covering the resection area and for setting the microflaps. Microphonosurgery cannot be dissociated from speech therapy, the planning and duration of which, in relation to the procedure, depend on the nature of the initial lesion. Twenty to 30 sessions are usually adequate, but 6 months may be necessary in the case of sulcus vergetures. Our operating technique is derived from the microphonosurgery procedures with cold instruments. In addition to the classic advantage with regard to hemostasis, the carbon dioxide laser micropoint seems to make the dissection of microflaps easier.

# 161

**USE OF THE CO2-LASER MICROPOINT MICROMANIPULATOR FOR THE TREATMENT OF LARYNGOMALACIA.**

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Twenty-eight children (21 boys, 7 girls) with moderate to severe symptoms due to laryngomalacia underwent endoscopic surgery using the CO2-laser micropoint manipulator (shot-by-shot, 0.1 s, super-pulse, 2-3 W power; 250 microns beam; 350 mm working distance). Mean age of the children was 5 months (range, 1-11 months). The procedure was performed under high-frequency jet ventilation and consisted in the resection and/or vaporization of the aryepiglottic folds. This tissue removal could be extended to the laryngeal mucosa of the arytenoids and the lateral edge of the epiglottis. Results of surgery were excellent with normalization (8 patients) or, at worst, a very definite improvement of symptoms (4 patients). Furthermore, no complications occurred due to the technique used. These results have convinced us that the CO2-laser micropoint manipulator technique, with the "super-pulse" shooting mode and high-frequency jet ventilation, is by far superior to microsurgery with cold instruments when endoscopic treatment of laryngomalacia is indicated.

# 162

LASER TREATMENT OF PEDIATRIC AIRWAY DISORDERS
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The laser is a valuable tool in the treatment of airway abnormalities in infants and young children. Difficult problems such as laryngomalacia, vocal cord paralysis, hemangiomas, laryngotracheal stenosis, and recurrent respiratory papillomatosis are amenable to laser surgery. These less invasive approaches lead to rapid healing with less problems. Newer laser technologies have increased the capabilities of laser surgery in the airway.
We will review the current "state of the art" of laser treatment for pediatric airway lesions. The latest laser technologies will be reviewed. We will discuss the approach to severe laryngomalacia including the technique of the laser epiglottoplasty using the $CO_2$ laser. Indications as well as operative and postoperative management will be discussed. In addition, the laser surgical approach to bilateral vocal cord paralysis will be reviewed and compared to other methods of surgical treatment. We will also discuss the indications for laser treatment of subglottic stenosis and subglottis hemangiomas. We will also review the surgical treatment for laryngeal papillomatosis including a discussion of adjuvant therapies.
With each abnormality we will discuss the various operative and anesthetic approaches including jet ventilation, spontaneous ventilation, apneic technique. A short video will be included. Future applications of the laser in the pediatric airway will be addressed as well.

# 163

ANESTHESIA FOR LASER AIRWAY SURGERY
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Purpose: To review safe anesthetic practices for patients undergoing laser airway surgery.
Methods: Review of current anesthesia and otolaryngology literature.
Results: The importance of safe anesthetic management for patients undergoing laser airway surgery cannot be stressed enough in order to reduce patient morbidity or mortality. The special anesthetic considerations for patients undergoing these types of procedures starts with the preoperative evaluation of the extent of impending airway compromise as well as a discussion with the surgeon of the procedure to be performed. Awake-sedated fiberoptic intubation with spontaneous ventilation is utilized in patients with severe airway obstruction. A laser-safe environment needs to be enforced to minimize injury to all personnel in the operating room. Non-combustible anesthetics, warning signs at all entrances, safety glasses, eye shields, saline soaked towels placed over the patient, and flame retarded drapes are required. Intraoperatively, the choice of 'laser-safe' endotracheal tubes and the anesthetic gases are of concern to minimize airway fires. Anesthetic management via general anesthesia may be conducted with or without an endotracheal tube. General anesthesia may be maintained via inhalation or intravenous routes. Special techniques such as Venturi jet ventilation, intermittent apneic technique, or insufflation may be utilized. The major complication of carbon dioxide laryngeal surgery is endotracheal tube fires or explosions. All operating room personnel must be prepared for the possibility of an airway fire. A plan of action should be rehearsed by the personnel so rapid action can be taken. Postoperatively, stridor, excessive coughing, or bronchospasm should warrant immediate investigation.
Conclusion: Anesthesia for laser surgery of the airway can be safely performed. Special precautions should be taken in order to reduce morbidity.

# 164

**Respiratory Incompetence of the Larynx at Fryns Dysmorphia Syndrome**

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**Case report (video)**
The rare case of a combined disturbance of the function of the larynx at a dysmorphia syndrome is presented. We saw a newborn child with breathlessness, blue discoloration of the skin and swallow inability.

Beside the breathing – problems following illnesses exist:
1. Dysmorphia syndrome (Fryns – syndrome) with Dandy Walker malformation of the brain
2. Bronchopulmonary dysplasia grade II
3. Tricuspid regurgitation grade I
4. Kidney dysplasia

In the flexible endoscopy we saw a supraglottic instability of the larynx and a small hemangioma of the left false fold. The findings will be presented by the video. First we assumed, that the small hemangioma of the left false fold is responsible for the respiratory handicap. The hemangioma became removed in the 4 week of life of the child. After that the breathing function did not improve. Since nasal CPAP treatment could not solve the problem, we tracheotomized the small boy in it 6 week of life. At today, the boy is one year old. Meanwhile the larynx is stable and we plan to close the tracheostomy. The child shows a severe statomotoric retardation and can be nourished only via PEG. It should be discussed, whether the tracheostomy would have been avoided through a laser supraglottoplasty.

# PHOTODYNAMIC THERAPY/ONCOLOGY

# 167*

USE OF HALOGENATED XANTHENES AS PHOTODYNAMIC AGENTS. C. Dees, J. Harkins, M. Petersen, T. Scott, E.A.Wachter, G. Wolf. Photogen, Inc. Knoxville, TN 37931

The cost of porphyrin-based photodynamic agents may be prohibitively expensive if diseases with non-lethal consequences like psoriasis are to be treated. Additionally,

porphyrins delivered by intravenous injection increases the chances of adverse effects like esophageal penetration after PDT treatment for Barretts esophagus. Halogenated xanthenes, some of which have FDA clearance as diagnostic agents or food additives, offer an inexpensive replacement to treat a wide variety of conditions including psoriasis, cutaneous or superficial neoplasia and Barretts esophagus. We compared the ability of a variety of halogenated xanthenes to kill *in vitro* multi-antibiotic resistant *Staphylococcus aureus*. Rose Bengal was found to kill *S. aureus* much more quickly than sodium porfimer. Comparison of a number of halogenated xanthenes using this assay showed that bacterial killing by Rose Bengal ≥Phloxine B >Erythrosin B >Eosin Y>Eosin B. Diiodofluorescein failed to kill under these conditions. Rose Bengal was also used to kill subcutaneous neoplasias in mice. Rose Bengal was found to preferentially stain diseased tissue as opposed to indocyanine green that exhibited a preference for normal tissue. Halogenated xanthenes may be the PDT agent of choice for superficial conditions.

# 168

Evaluation of the Third Generation Photosensitizer Bacteriochlorin ( m-THPBC) in the Rabbit Model Yael Ptachewich Halaas, Jacob Oberstein, Avigdor M. Ronn Albert Einstein Medical College, Long Island Jewish Medical Center, New Hyde Park, New York

The plasma pharmacokinetics and tissue uptake biodistribution of the third generation photosensitizer Bacteriochlorin were characterized in the rabbit model. The protocol for the experiment was based on prior studies of temoporfin ( m-THPC) and its other derivatives. The plasma pharmacokinetics of the photosensitizer were first studied to define the potential optimal treatment interval whereas the second part of the study involved refining the exact timing by studying the static distribution of the compound into the various end organs at selected time intervals. The evaluation of the plasma and tissues' photosensitizer content were conducted by both spectroflourometry and absorption spectroscopy. Both studies involved injecting 1mg/kg of the m-THPBC into the ear veins of two Dutch-belted rabbits. The initial test animals were then sampled for plasma and skin levels at 1, 3, 6, 24, 48, and 72 hours. The t1/2 of the compound was calculated at 8 ½ hours. The skin levels were highest approximately at 24 hours at levels ranging from 4.48 to 7.68 ng which then dropped to a median of 1.92 ng by 72 hours. The second part of the study required sacrifice of the animals at 5 hours post-injection and 24 hours post-injection so as to allow for full assays. At five hours, the m-THPBC was most heavily concentrated in the liver and lung. Tongue, kidney, heart and oral mucosa also revealed significant levels. Of note, skeletal muscle, brain and bone revealed little or no uptake of the m-THPBC. At 24 hours, the biodistribution was similar except for a general increase in total concentration. The next phase of this study will focus on the evaluation of the photodynamic treatment efficacy of Bacteriochlorin in the same rabbit model. Given the long wavelength absorption for m-THPBC, 740nm and the phamacokinetic profile discussed above, we believe that m-THPBC can become an exciting new photosensitizer.

# 169

COMPARISON OF PORPHYCENE AND HYPERICIN LASER PHOTOTHERAPY OF SQUAMOUS CELL CARCINOMA. Saxton RE, Chung PS, Chung JE, and Castro DJ. Department of Surgery, UCLA School of Medicine, Los Angeles California; UCSF School of Medicine, San Francisco, CA (JEC); Department of Head and Neck Surgery, Dankook University School of Medicine, Dankook, Korea (PSC).

Purpose: A synthetic porphycene dye and hypericin were compared *in vitro* and *in vivo* as photosensitizers for phototherapy of human squamous cell carcinoma (SCCA). Methods: Uptake of hypericin (HP) or capronyloxy tetrakis methoxyethyl porphycene (CTMP) was measured by dye fluorescence spectroscopy in SCCA cells and tumors transplanted in nude mice. Phototherapy via KTP532 laser illumination was measured by MTT assays and tumor response.

Results: Nanomolar HP uptake levels by SCCA cells were 2-fold greater than CTMP and laser phototoxicity was increased 4-fold. Injection of HP or CTMP directly into SCCA transplants in mice led to dye fluorescence reaching the tumors margins within 4 hours. Phototherapy via fiberoptic insertion in these dye sensitized tumors resulted in complete regression in 14/20 cases after HP injection compared to 9/20 after CTMP and only 3/20 of the laser alone treated control SCCA tumors.

Conclusions: Hypericin dye and the KTP laser were the most effective combination for both *in vitro* and *in situ* phototherapy of human squamous cell carcinoma tumors in preclinical studies. Further testing of treatment efficacy and toxicity are indicated before clinical evaluation in cancer patients.

# 170

AUTOFLUORESCENCE CHARACTERISTICS OF ORAL NEOPLASIAS: A CONFOCAL STUDY

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**Purpose:** To determine autofluorescence characteristics of oral tissues covering the full spectrum of cancer progression, from normal through dysplasia to carcinoma, utilizing the confocal microscope.

**Methods:** Tumor tissue samples were collected at time of resection and snap frozen. Samples were collected so as to contain both normal and tumor border. Normal oral tissue was obtained from autopsy specimens. 10μm cryostat sections were cut in the dark, and examined using the Zeiss confocal microscope, using excitation wavelengths and emission windows shown to discern dysplasia/carcinoma from surrounding normal mucosa. Routine H+E staining was then performed on the sections, which were interpreted by an oral pathologist. Fluorescence findings were compared to the 'Gold Standard' of histopathology.

**Results:** Good correlation between certain fluorescence characteristics and significant pathology was shown. Features such as keratin pearls and eosinophilia contributed to the unique fluorescence signature of the dysplastic/cancerous tissues.

**Conclusions:** These promising results show the utility of using the fluorescence signature of tissue to discern normal from neoplastic tissues in the oral cavity. This data will be of great value in the construction of an autofluorescence imaging system to be used in the detection of early stage oral cancers.

# 171*

**PROLONGED CIRCULATION OF INDOCYANINE GREEN INCORPORATED IN LIPOSOMES**

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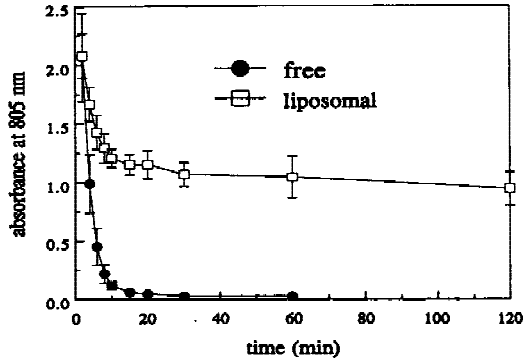
The use of indocyanine green (ICG) as an exogenous chromophore for photothermal targeting of pathologic blood vessels has been limited because of its short circulatory half-life when administered in aqueous solution. This study examines the potential of long-circulating liposomes to provide stable levels of ICG in the blood sufficient for selective photothermal ablation. Small, rigid liposomes composed of egg phosphatidylcholine, cholesterol, and ICG were administered to rats and blood samples taken using a jugular vein catheter. Clearance of liposomal ICG was determined by absorption measurements of plasma, and compared to that of free ICG. Results indicate that the liposomal formulation has a substantial long-circulating component, as shown below for a 6 mg/kg body weight ICG dose. Liposomal ICG may prove useful for eradication of tumor vasculature and other types of relatively large or deep blood vessels.




# 172

**Effect of photodynamic therapy on the expression of pro-apoptotic gene Bak in nasopharyngeal carcinoma**

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**Nasopharyngeal carcinoma(NPC) is one of the most prevalent malignancies in southern China. Generally, radiotherapy is the first chosen therapeutic method, however, the persistent or recurrence tumor after radiotherapy is more difficult to manage. Photodynamic therapy(PDT) is new therapeutic method for malignancies, we have found the satisfied therapeutic effectiveness in the persistent and recurrence NPC after radiotherapy, but the mechanism is not clear. In present study, we determined pre- and post-PDT expression of pro-apoptotic gene Bak protein, among 24 persistent or recurrent NPC ,using the immunohistochemistry method. The result showed that up-regulation Bak protein expression was found in 75%(18/24) of NPC after PDT, 13 of the 15 NPC with good prognosis was found strong Bak expression in the plasm of NPC cells. The results suggest that PDT might induce NPC cell death by inducing apoptosis, and partially relate with the up-regulation of pro-apoptotic Bak gene expression.**

# 173

LIGHT AND TEMPERATURE DISTRIBUTION DURING LASER-INDUCED THERMOTHERAPY OF LIVER METASTASES

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Laser-induced thermotherapy (LITT) is a promising treatment for destroying liver tumors. For predicting the effects of laser applications and optimizing irradiation planning in LITT the knowledge about light and temperature distribution in tissue (optical/ thermal properties; absorption, scattering, penetration depth) and their heat induced changes is indispensable. LITT (5W, 900 s, 1064 nm) was performed in 20 chinchilla-bastard rabbits with intrahepatic VX2-tumors (26±3mm diameter) and 20 healthy animals. In vivo temperature measurements were performed online in defined distances from the applicator (5/10mm). The optical properties were determined before and after heat exposure using a double integrating sphere system.

| | Absorption ($mm^{-1}$) | Scattering ($mm^{-1}$) | Opt.penetr. depth (mm) | Temperature (°C) 5 mm | 10 mm |
|---|---|---|---|---|---|
| VX2 | 0.017 ±0.001 | 7.32 ±0.1 | 5.5 ±0.16 | 62.3 ±3.3 | 54.2 ±3.8 |
| Liver | 0.034 ±0.002 | 10.8 ±0.3 | 2.7 ±0.24 | 72.3 ±4.2 | 48.7 ±2.8 |

Absorption and scattering coefficients were significantly smaller in tumor tissue, resulting in a higher optical pentration depth ($p<0.01$). Compared to normal liver tissue, temperatures in the tumor were lower close to and higher distant from the applicator ($p<0.01$). Heat exposure during LITT was accompanied by a decrease in optical and thermal penetration depth. 1. Intrahepatic light and temperature distribution in LITT differ significantly between normal liver tissue and tumorous liver tissue. 2. The higher optical and thermal penetration depth in liver tumors is advantageous in LITT, since larger tumor volumes can be irradiated and thus treated by appopriately adjusted laser power. 3. It is recommended to adapt laser power during therapy due to the ongoing changes of tissue properties under the influence of tissue heating.

# 174

**MONITORING OF ALA-PDT EFFECTS USING INFRARED THERMOGRAPHY, LASER DOPPLER PERFUSION IMAGING AND TWO FLUORESCENCE DETECTION SYSTEMS**

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In the ALA-PDT treatment of histological proven precancerosis and superficial skin tumors we use two fluorescence detection systems. SIMAS (Spectroscopic Imaging System) allows a qualitative estimation of the fluorescence after ALA application and visualization of the whole extent of the lesion for the correct adjustment of the irradiation field. LENA (Laserinduced Endoscopic Autofluorescencesystem) enables us to do a quantitative point measurement especially of the PPIX fluorescence to compare normal skin with pathologic areas.
Before laser treatment as well as during the laser light exposure we practise a continous monitoring of the irradiated area with a nitrogen cooled infrared thermography camera to survey the course of the superficial temperature.
In addition we performe pictures of the superficial perfusion with a two dimensional laser doppler scanner before treatment and in the shorttime follow-up to visualize and quantify the reactive capillary hyperperfusion in the exposed area.
Our experiences show, that the methods mentioned above are easy to perform and give useful advice in the course of PDT.